

The Weather Bureau places thermometers in alfalfa and tomato fields every fall about August 20 and receives telegraphic reports daily from all stations of their temperatures, and the information is handled in the same way as with fruit in the spring.

## IX.

# NOTES ON FROST PROTECTION IN THE VICINITY OF KNOXVILLE, TENN.

By J. F. VOORHEES, Local Forecaster.

[Dated Weather Bureau, Knoxville, Tenn., Nov. 28, 1914.]

Protection from frost has not been practiced in this State except on a small scale and generally in a more or less experimental way. A few orchardists have fired their orchards regularly for several seasons and a number of others have built fires occasionally. In most cases there has followed a crop of fruit where the firing was done, but usually some of those who did not fire have also had a crop which makes it very hard to determine just what the benefit of the firing has been. The general opinion, however, seems to be that firing pays, and the amount of firing done each year is, I believe, on the increase.

The topography here is such that it is impossible, except in rare cases, for orchardists to cooperate, as the orchards are widely scattered, each on its own hillside.

A variety of fuels have been used with about equal success as far as protection was concerned. It appears, therefore, that the cost of fuel and work of handling it would be the factor that would determine which is best for any individual.

The principal fuels used here are straw, old stumps, coal, and crude oil. Where there are many stumps in an orchard they should of course be used, as by that means the stumps are removed economically. Soft coal has been the favorite fuel in this region so far, because for a given amount of heat it is much cheaper than crude oil at prevailing prices. The oil is being used in some cases because of the greater ease in handling, but in one experiment at the University of Tennessee Fruit Farm, when a cold wave arrived during a snowstorm, the oil failed because the falling snow caused it all to pop out of the container in which it was burning.

The need for frost protection is very irregular. In some years no protection is needed while other years occur in which several firings would be necessary to save a fruit crop. Sometimes the freeze comes on a still night when protection is comparatively easy, and again it comes with a high wind that makes protection very difficult if not impossible.

Under these conditions it is difficult to get any but those whose living depends on the orchard to take the trouble to prepare to protect from frost. Still the number who try to protect their fruit is increasing and should be increased many fold.

protection. Frost warnings are of no benefit to farmers who do not protect their crops. I judge that not over 10 per cent of the fruit growers use protective measures, but as the crop runs into millions of dollars this 10 per cent amounts to several hundred thousand dollars.

Two classes of frost forecasts are made here: One wherein the information is conveyed in general terms, e. g., light, heavy, or killing frost expected, and the other in specific terms, by the statement that the minimum temperature next morning will be 26°, 28° or 30°, as the case may be. The latter forecast is sent to a central point where protection work is done, such as Medford, Oreg., North Yakima, Wash., and Boise, Idaho. When received at these places a local man amplifies it to fit still more restricted localities; and when the distribution is made, which is done by telephone, practically every horticulturist in the neighborhood knows just what temperature to expect, and can prepare himself accordingly. By means of these forecasts many orchardists have saved a crop that would otherwise have been a total loss. Just what credit the Weather Bureau should receive can not be accurately determined. It is probable it will amount to \$100,000 or more every year when damaging frosts occur. Some of the orchardists would save their crops if they did not get the warnings, as they always are on the watch for frosts and get very little sleep on this account during the frost season, but the majority depend upon Weather Bureau warnings and at times they would suffer severely without them.

Most of the orchardists use oil burners to heat their orchards, but a few use wood. A great many use prunings for their first fire, and after they are burned no more protection work is done, consequently they are prepared for only one frost, and if another occurs they lose their crop and have nothing to show for the work previously done.

Orchard-heating systems are slowly improving. The first mistakes were in not having enough pots to the acre. After these were increased it was found that the style in use gave the most heat shortly after being lighted, whereas early in the morning when the most heat was wanted the fires were burning low and not enough was obtained. As fast as improvements are being made in the heating apparatus the number of orchardists engaged in the work increases.

It has been proved that the temperature can be raised by 6° or even 10°F. in an orchard by heating methods, and this is sufficient in every case, so far as I know, to save a crop in the North Pacific States, where on frosty mornings the temperatures never go more than 10° below the freezing point.

Some think the orchard business has been overdone in the North Pacific States; hence during the last two years not so many new orchards have been planted. For the preceding five or six years the increase of orchard acreage had been enormous. During the next two or three years the new trees then coming into bearing will make the necessity for frost warnings greater than ever.

Orchard heating is used mostly by the apple growers, less by those who raise pears, and still less by the peach, prune, and cherry growers.

The localized districts now in operation are known as the Rogue River Valley, with Medford, Oreg., as the central point; the Yakima Valley, with North Yakima, Wash., as the central point; the Boise Valley, with headquarters at Boise, Idaho. A new district will be operated next spring to take in the orchards in the neighborhood of Walla Walla, Wash. In this latter district the trees are just coming into bearing and these orchardists were not heretofore interested in protection work.

# FROST FORECASTS AND PROTECTION IN OREGON, WASHINGTON, AND IDAHO.

By EDWARD A. BEALS, District Forecaster.

[Dated Weather Bureau, Portland, Oreg., Nov. 28, 1914.]

Those receiving the most benefit from frost warnings are the horticulturists who have commercial orchards. No one else is prepared to do anything in the way of